

are not frequent visitors. A *Paradoxurus typus* just caught was brought to me for sale; the *Herpestes griseus*, or common large Mongoose, is sometimes found; the *Canis aureus* is very common, and in the park of Barrackpoore I have seen this animal (the Jackal of India) allow carriages to pass within a few yards of it, whilst they composedly sat down; the common Fox, *Vulpes bengalensis*, is also found.

Amongst the Rats I obtained *Mus indicus*, *M. flavescens*, *M. nemoralis*, *M. decumanus* and *M. manei*; also *Sorex murinus*, and another *Sorex* which may prove a new species or a very dark variety of the former; the *Sciurus palmarum* is very common.

Amongst the Bats I obtained *Nycticejus castaneus*, *N. luteus*, *Rhinolophus lepidus*, *Taphozaus longimanus*, *Megaderma lyra*, *Cynopterus marginatus* and *Pteropus edwardsii*, all very common; this latter is the Flying Fox of India. Thus ends my list of mammalia found at Barrackpoore: that several other species exist there can be no doubt, yet as I failed to obtain them I refrain from mentioning them. I must not omit mentioning that I received every assistance from my friends E. Blyth, Esq., and Jas. Curr, Esq., during my stay at Barrackpoore, to whom I offer my best thanks.

XXXII.—*Contributions to the Palæontology of Gloucestershire:—A description, with Figures, of some new Species of Echinodermata from the Lias and Oolites.* By THOMAS WRIGHT, M.D. &c., Professor of the Natural Sciences in the Cheltenham Grammar School.

[Concluded from p. 324.]

Ophioderma Gaveyi, Wright, 1852. Pl. XIII. fig. 1 a-c.

Diagnosis.—Disc large, upper surface not exposed, under surface with five pairs of heartshaped plates, above which the five rays pass; the median scutal plates of the rays form a ridge in the centre of each pair of plates; the mouth-opening is surrounded with five pairs of very prominent toothlike processes; the rays are slender and gently tapering; the central scutal plates on the dorsal and ventral surfaces of the rays are narrow, those on the ventral surface resemble the bodies of small vertebræ deprived of their neural elements.

Transverse diameter of the body-disc 1 inch and $\frac{2}{10}$ ths, transverse diameter of the rays at their junction with the disc nearly $\frac{3}{10}$ ths of an inch.

Description.—This Sea-star must have been rather abundant in the Liassic sea; we have seen many fine specimens of it, and

numerous fragments of others in the locality where it was collected. The body-disc is large and pentagonal, it is composed underneath of ten thin, delicate triangular plates arranged in pairs, each pair forming a heartshaped shield, having an elevated rugose carina down its centre, formed by the median element of the ventral scutal plates which protrudes between each of the two plates forming a pair; the five shields are otherwise smooth on their under surface, and were united together in the living state by a membrane, but in the specimen before us they are quite separate from each other; at the apex of each of the ten triangular plates a sharp toothlike process projects downwards, which together form an imposing dental circle around the mouth-opening. The rays are long, slender, and gently tapering; we have not been able to measure the absolute length of one, as those which we have met with were always fractured; the dorsal median pieces of the rays are hexagonal and elongated transversely, the ventral median pieces are elongated in the direction of the length of the ray, and resemble the bodies of small vertebræ which had been deprived of their neural arches; the marginal plates are rounded and finely imbricated, their outward free border is toothed with five or six pectinated processes, which in the living state supported as many spines; the remains of these are sometimes seen attached to their supports; the lateral scutal plates clasp the rays firmly and securely, and overlap the median pieces both above and below.

Affinities and differences.—This elegant Sea-star somewhat resembles in its general contour *Ophioderma Milleri*, but it is distinguished from that marlstone species by having a proportionately larger body-disc, with more slender and more tapering rays: in the form and structure of the scutal elements of the rays themselves there is likewise a difference, those in *O. Milleri* are of a more elongated and regular form, whilst in *O. Gaveyi* they are shorter, more ridgy and vertebrate-like; the ten triangular ventral discal plates are smaller in *O. Milleri* than in *O. Gaveyi*; they want likewise, in the figures given by Mr. Charlesworth in the London Geological Journal, the toothlike spines at their apices which are so characteristic of our *Ophiura*.

Locality and stratigraphical range.—This Sea-star was collected by Mr. Gavey from the upper shales of the Lower Lias at Mickleton Tunnel near Chipping Campden, Gloucestershire, whilst making the Oxford, Worcester and Wolverhampton Railway; and we have found some fragments of a Sea-star much resembling in structure this species in a Liasic bed of the same horizon at Hewlitt's Hill near Cheltenham, during the excavation of the new reservoir of the Water Works Company of that town.

We dedicate this species to our friend Mr. G. E. Gavey, whose

careful and minute investigation of the beds exposed in the section which he has so well described*, added to the discovery of new forms of Radiata and Mollusca in the same, has enriched our knowledge of the Liasic fauna of Gloucestershire.

Ophioderma Griesbachii, Wright. Pl. XIII. fig. 2 *a*, *b*.

Diagnosis.—Body-disc small, upper surface not exposed, under surface irregularly subpentagonal, formed of five pairs of heart-shaped plates; rays long, slender, and awl-shaped, prolonged beneath into the centre of the body-disc; inferior surface with median vertebrate-like elements, and lateral scutal plates in the form of oblique pyramidal pieces, which clasp the sides of the rays in an imbricated manner, and support at their terminal points short stout spines; mouth subpentagonal, surrounded by ten blunt spinous processes, formed by the development of the first lateral scutal plates of the rays, where they join each other around the mouth.

Diameter of the body-disc $\frac{7}{8}$ ths of an inch, length of the rays from the mouth-margin to their apex $\frac{1}{2}\frac{5}{8}$ ths of an inch.

Description.—This beautiful Brittle-star of the Oolitic sea was discovered by our friend the Rev. A. W. Griesbach, of Wollaston, and we owe to his kindness and liberality the series of exquisite specimens before us, by which we have been enabled to complete the description of this new fossil. The body-disc is small, consisting of five pairs of heart-shaped plates; the union between the separate elements of the disc was very intimate, as it is only at one or two points that a suture is exhibited; so close is the union, that in other specimens the body-disc seems to be formed of a single circular element; each pair of plates has a heart-shaped form, and the ray corresponding thereto stands out in bold relief from the under surface of the disc. In none of the specimens found is the upper surface of the disc exposed, and we know not with certainty what kind of ornamentation adorned its dorsal surface; at one part, however, where a portion of one of the plates is weathered, we think we detected with our inch object-glass under the microscope, a series of small imbricated scales resting on the rock surface; the rays are long, slender, and gently tapering; their under surface, the only one exposed, exhibits, 1st, a central element having an elongated form, which resembles the body of a fish's vertebræ in miniature; 2nd, lateral elements more largely developed, consisting of triangular plates of a pyramidal form slightly twisted round, by which arrangement the apices of the pyramids are made to clasp

* Railway Cuttings at Mickleton Tunnel and Aston Magna, by G. E. Gavey, Quart. Journ. Geol. Soc. February 7, 1853.

each other, and thereby produce a regular imbricated structure ; the points of the lateral plates support small, short, stout spines, which are only seen in one of the rays of the three specimens before us. Where the base of the ray crosses the under surface of the body-disc it is firmly attached thereto, and as they approach the centre, each of the lateral plates of the rays becomes greatly developed, and form by their union five channels, which extend into the mouth ; this opening is in the centre of the disc, and has a subpentagonal form ; it is of a moderate size, and is surrounded by ten stout spines formed by the development of the first lateral plates, which are much expanded and terminate at the oral border in short stout spinous processes ; the lateral plates from the adjoining rays are here united together, so that two spines from the lateral plates of different rays are closely approximated, and the five rays are thereby united together round the mouth-opening like five Gothic arches, so that the mouth with its channels, formed by these arches, resembles a miniature starfish in the centre of the disc ; the five pairs of spines may have served as jaws.

Affinities and differences.—Our knowledge of fossil *Ophiurida* is unfortunately so limited, and the details of those forms known are so meagre, that there is much difficulty in making a comparison between the extinct genera of this family. In our description of *Ophioderma Gaveyi* a diagnosis has been attempted between it and *O. Milleri*, Phil., both of these being Liasic species. The other forms hitherto published are those figured by Goldfuss, namely the *Ophiura prisca*, Münster, from the Muschelkalk of Baireuth ; the *Ophiura loricata*, Goldf., from the Muschelkalk of Würtemberg ; the *Ophiura speciosa* and *O. carinata*, Münster, from the Lithographic slates of Solenhofen ; of these Goldfuss's figures are excellent, and leave nothing to be desired, as that able natural-history artist Herr Hohe, whose crayon has added such lasting value to the 'Petrefacta Germaniæ,' has given accurate details of structure which prevent the possibility of confusion regarding the identification of the species drawn by him.

The *Ophiura Egertoni*, Brod.*, found in nodules of micaceous sandstone at the base of the Inferior Oolite near Charmouth, is so entirely distinct from our fossil, that to mistake them is impossible ; between *O. Griesbachii* and *O. speciosa* and *O. carinata*, the difference is likewise very great ; *O. loricata* comes nearer to our Brittle-star than either of the others, but the great development of the lateral plates of the rays, and the clasping and imbricated character of the same in *O. Griesbachii*, forms a structural character which separates it widely from Goldfuss's species.

* Geol. Trans. 2nd series, vol. v. pl. 12.

If we seek further for resemblances to our Brittle-star, we must look for them more amongst the beautiful *Ophiocomæ* of our seas than among any forms we are acquainted with in the fossil state, but even between it and them the differences are many and distinct.

Locality and stratigraphical range.—This beautiful fossil was collected by the Rev. A. W. Griesbach from the Forest marble of Oundle, Northamptonshire, where it is rare. We have dedicated this species to that gentleman, to whom we are indebted for much valuable information relative to the stratigraphical distribution of Echinoderms in his county, and likewise for a liberal contribution of materials to aid us in the completion of these memoirs.

Pentacrinus Goldfussii, Wright. Pl. XIII. fig. 3.

Diagnosis.—Calyx composed of a central pentagonal plate, five small heart-shaped pieces, and five large triangular basal elements; rays thick, strong and bifurcated; total number of their subdivisions unknown; the five primary rays consist of two pieces, the basal piece is flat, and has a slightly elevated portion about the centre of the upper surface, the brachial piece is strong and triangular, its base resting firmly on the former; the sides of the triangle support two arms; the ten secondary rays consist of from ten to eleven circular pieces with smooth unequal undulated surfaces, whereby their thickness is rendered very unequal; the secondary rays support twenty tertiary rays, which have the same general character as the secondary rays; the number of pieces entering into the composition of each is unknown; from the fragmentary state of this part of the specimen the number may be estimated at from fifteen to twenty pieces. The column near the calyx is composed of thin, deeply divided five-rayed plates, with well-marked transverse articular impressions on their surfaces; every fourth plate is thicker, broader, and more prominent than the one above it or below it; the side arms are numerous, and composed of thin circular plates: the lower part of the column is unknown.

Description.—This beautiful Sea Lily is remarkable among its Liassic congeners for the comparative strength and thickness of its rays; the centrum of the calyx is simply a thickened and enlarged columnar joint to which the upper part of the column is articulated; around the apices of the rays of this centrum five small heart-shaped basal pieces are inserted, the points of which are directed outwards; they are very convex externally, projecting from the surface of the calyx, and have the appearance of

five mammillary eminences disposed around the union of the column with the calyx.

The rays are short and robust; the primary portion consists of two pieces, a flat basal plate and a triangular brachial plate; the basal plate has a slight elevation on its outer and upper articular surface; the brachial plate has the form of an equilateral triangle, it is very convex externally, and has its base firmly planted on the flat basal plate, and its sides support the secondary rays; these are ten in number, and consist of from ten to eleven circular plates, each differing in form and thickness from the other, their articular surfaces being smooth and undulated in different directions, the elevations of the one plate always corresponding to the depressions of the other with which it is articulated; these inequalities are well seen in the specimen before us; from the various angles at which these plates lie in relation to each other, the ultimate brachial piece of each of the secondary rays has a triangular form externally, the sides of which support the tertiary rays; these, like the secondary rays, consist of unequal-sized plates with undulated articular surfaces, which are marked with fine lines that radiate from the centre to the circumference; the number of the elements in these tertiary rays cannot be accurately made out in consequence of the imperfection of this part of the skeleton; judging however from the remains of the plates in a part of the slab once occupied by a tertiary ray, we estimate their number to have been from fifteen to twenty. The inferior surface of the centre of the calyx exhibits a depression produced by the convexity of the brachial elements and the prominence of the heart-shaped basal pieces; into this depression the summit of the column closely fits. It is unfortunate that so small a portion of the column of this Crinoid is preserved, as it is possible that the lower part of the stem was different from that which is preserved; the upper part of the column before us consists of thin star-shaped plates, the rays of which are deeply divided, and their surfaces are sculptured with well-marked transverse articular processes; between every third plate a thicker and broader plate is introduced; the side-arms appear to have been numerous about the upper part of the column; they were composed of thin circular plates having undulated surfaces similar to those observed on the secondary and tertiary rays.

Affinities and differences.—*Pentacrinus Goldfussii* resembles in some points *P. tuberculatus*, Mill.: through the kindness of Major Austin and Mr. Etheridge we had the privilege of comparing our fossil with Miller's type specimen in the Bristol Museum, but the imperfection of that Crinoid makes a rigorous comparison impossible; one point of difference which Miller thought specific

of *P. tuberculatus* he thus describes: "The column differs in its joints, being thinner, and their having been covered all over with a more conspicuous muscular coat, which shows itself in numerous minute tubercles the result of its contraction*:" this character is certainly absent in our fossil. It is distinguished from *P. briareus*, Mill., *P. subangularis*, Mill., and *P. scalaris*, Goldf., by the absence of lateral branches from the rays, and from all others of its Liasic congeners with which we are acquainted in the strength and thickness of the rays themselves.

Locality and stratigraphical range.—This remarkable Sea Lily was discovered by Mr. R. E. Gavey, C.E., in the Lower Lias of Mickleton Tunnel near Chipping Campden, Gloucestershire; it is imbedded in shale resting on a hard slab of limestone, and was associated with the remains of other Radiata.

We dedicate this fine Liasic Crinoid to the memory of the late Prof. Goldfuss, whose great work, 'Petrefacta Germaniæ,' has so much increased our knowledge of the Liasic and Oolitic fauna.

A Tabular View of the Stratigraphical Distribution of the New Species described in this Memoir.

Genera and Species.	Authority.	Lower Lias.	Marlstone.	Upper Lias.	Inferior Oolite.	Great Oolite.	Cornbrash.	Forest Marble.	Coralline Oolite.
<i>Cidaris Edwardsii</i>	Wright ...	*							
— <i>Bouchardii</i>	Wright ...	...	...	...	*				
<i>Hemicidaris minor</i>	Agassiz ...	...	...	...	...	*			
<i>Acrosalenia crinifera</i>	Quenstedt	*							
<i>Diadema Davidsoni</i>	Wright ...	...	...	...	...	...	...	...	*
— <i>Moorei</i>	Wright ...	...	...	*					
<i>Pedina Bakeri</i>	Wright ...	...	...	...	*				
— <i>Etheridgii</i>	Wright ...	...	...	*	*				
<i>Polycyphus nodulosus</i> ...	Münster ...	...	...	...	...	*	*		
— <i>Deslongchampsii</i> ...	Wright ...	...	...	...	*				
<i>Nucleolites Woodwardii</i> ...	Wright ...	...	...	...	...	*			
— <i>Michelinii</i>	Wright ...	...	...	...	*				
— <i>scutatus</i>	Lamarck...	...	...	...	...	...	...	...	*
<i>Ophioderma Gaveyi</i>	Wright ...	*							
— <i>Griesbachii</i>	Wright ...	...	...	...	...	...	...	*	
<i>Pentacrinus Goldfussii</i> ...	Wright ...	*							

* Miller's Crinoidea, p. 65.

EXPLANATION OF PLATES XI. XII. AND XIII.

PLATE XI.

- Fig. 1. *Cidaris Edwardsii*: *a*, natural size, and restored to its globular form; *b*, portion of an ambulacral area magnified, showing the pedal pores and tubercles; *c*, primary tubercle, with its circle of areal granules, magnified; *d*, one of the jaws and its tooth, of the natural size; *e*, secondary spine, natural size and magnified; *f*, primary spines, natural size and magnified.
- Fig. 2. *Cidaris Bouchardii*: *a*, *b*, natural size; *c*, primary tubercle and ambulacral area, magnified.
- Fig. 3. *Hemicidaris minor*: *a*, natural size; *b*, magnified two diameters; *c*, primary tubercle and ambulacral area, magnified.
- Fig. 4. *Pedina Bakeri*: *a*, natural size; *b*, magnified one and a half diameter; *c*, primary tubercle and ambulacral area, magnified.
- Fig. 5. *Pedina Etheridgii*: *a*, natural size; *b*, upper surface and ovarian plates, magnified two diameters; *c*, under surface and mouth-opening, magnified two diameters; *d*, primary tubercle and ambulacral area, magnified.

PLATE XII.

- Fig. 1. *Acrosalenia crinifera*: *a*, natural size; *b*, upper surface, magnified three diameters; *c*, under surface, magnified three diameters; *d*, primary tubercle and lateral granules, magnified.
- Fig. 2. *Diadema Davidsoni*: *a*, under surface and mouth-opening, natural size; *b*, upper surface and anal opening, natural size; *c*, side view, showing the tubercles of both areas; *d*, base of one of the ambulacral areas, showing the clustering together of the pedal pores in this region; *e*, primary tubercle, ambulacral area, and pedal pores, magnified.
- Fig. 3. *Diadema Moorei*: *a*, natural size; *b*, upper surface and ovarian disc, magnified two diameters; *c*, under surface and mouth-opening, magnified two diameters; *d*, primary tubercle, circle of granules, and pedal pores, magnified.
- Fig. 4. *Polycyphus Deslongchampsii*: *a*, natural size; *b*, upper surface and ovarian disc, magnified one and a half diameter; *c*, outline of the mouth-opening; *d*, genital and ocular plates of the ovarian disc, magnified; *e*, primary tubercle, areal granules, pedal pores, and ambulacral area enlarged.
- Fig. 5. *Nucleolites Woodwardii*: *a*, upper surface, of the natural size; *b*, side view, of the natural size; *c*, ambulacral area and pedal pores, magnified two and a half diameters; *d*, tubercles and areas, magnified; *e*, mouth-opening and ambulacral area, magnified one and a half diameter.
- Fig. 6. *Nucleolites Michelini*: *a*, upper surface, reduced one-third in size; *b*, lateral view, reduced one-third in size; *c*, a portion of the ambulacral area and pedal pores, natural size.

PLATE XIII.

- Fig. 1. *Ophioderma Gaveyi*: *a*, disk, with portion of the rays, natural size; *b*, part of the upper side of a ray, enlarged three diameters; *c*, under side, enlarged three diameters.
- Fig. 2. *Ophioderma Griesbachii*: *a*, natural size; *b*, disk and a part of the rays, enlarged three diameters.
- Fig. 3. *Pentacrinus Goldfussii*: natural size.